

## MULTI-CHANNEL AUDIO CAPTURE IN AN APPARATUS WITH CHANGEABLE MICROPHONE CONFIGURATIONS

### BACKGROUND

#### [0001] 1. Technical Field

[0002] The exemplary and non-limiting embodiments described herein relate generally to the detection and capture of audio signals and, more particularly, to the analysis of directional information of audio signals detected and captured by a mobile device.

#### [0003] 2. Brief Description of Prior Developments

[0004] Spatial audio capture involves the capture of sound for the subsequent reproduction and artificial re-creation of the sound. One type of spatial audio capture is binaural audio capture, in which microphones capture directional information as sound in a horizontal plane for the re-creation of the sound via speakers arranged to produce a three-dimensional (3-D) audio sensation through headphones. Another type of spatial audio capture is multichannel 5.1 audio capture, in which microphones capture directional information as sound in the horizontal plane and re-create that sound through five full-bandwidth channels and one low frequency effect channel to produce a 3-D audio sensation.

### SUMMARY

[0005] The following summary is merely intended to be exemplary. The summary is not intended to limit the scope of the claims.

[0006] In accordance with one aspect, an apparatus comprises: at least one processor, and at least one memory including computer program code, the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus to: provide an audio capture event wherein one or more microphone configurations are configured to provide one or more audio signals based on at least one acoustic signal from at least one acoustic source, at least one of the one or more microphone configurations being defined by a first position of a first microphone configuration on a first portion and a second position of a second microphone configuration on a second portion, the second portion being movable relative to the first portion.

[0007] In accordance with another aspect, a method comprises providing an audio capture event wherein one or more microphone configurations are configured to provide one or more audio signals based on at least one acoustic signal from at least one acoustic source, at least one of the one or more microphone configurations being defined by a first position of a first microphone configuration on a first portion and a second position of a second microphone configuration on a second portion, the second portion being movable relative to the first portion.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The foregoing aspects and other features are explained in the following description, taken in connection with the accompanying drawings, wherein:

[0009] FIG. 1A is a perspective view of a mobile device in a video capture orientation;

[0010] FIG. 1B is a schematic representation of positions of microphones in the mobile device in the orientation of FIG. 1A;

[0011] FIG. 2A is a perspective view of the mobile device with a cover thereof closed;

[0012] FIG. 2B is a schematic representation of positions of microphones in the mobile device in the orientation of FIG. 2A;

[0013] FIG. 3A is a perspective view of the mobile device in an audio capture orientation;

[0014] FIG. 3B is a schematic representation of positions of microphones in the mobile device in the orientation of FIG. 3A;

[0015] FIG. 4 is a graphical representation of the calculation of an angle of sound arriving at a device having a plurality of microphones;

[0016] FIG. 5A is a perspective view of a camera with a lens cover in a closed position;

[0017] FIG. 5B is a top view of the camera of FIG. 5A showing positions of microphones in the camera;

[0018] FIG. 6A is a perspective view of a camera with a lens cover in an open position;

[0019] FIG. 6B is a top view of the camera of FIG. 6A showing positions of microphones in the camera;

[0020] FIG. 7 is a perspective view of a camera in a landscape orientation showing locations of four microphones;

[0021] FIG. 8 is a perspective view of a camera in a video call orientation showing locations of four microphones;

[0022] FIG. 9 is a schematic view of a device showing a part that is moved to open and close a port in which a microphone is located;

[0023] FIG. 10 is a schematic view of a device showing a part that is moved to open and close a port to move an apparent location of a sensor in the device; and

[0024] FIG. 11 is a flow of one exemplary method of optimizing audio capture parameters in real time for a mobile device.

### DETAILED DESCRIPTION OF EMBODIMENT

[0025] Directional detection of sounds from one or more sound sources is optimal when the sound sources are arranged on the same plane with three or more directional microphones. In detecting the direction of sounds through such microphones, whether the sound source is located above or below a horizontal plane cannot be discerned. Nevertheless, when the microphone plane is horizontal, knowing whether the sound source was above or below the plane is of little value, since playback of the sound in a multichannel 5.1 audio format cannot reproduce sounds from above or below the horizontal plane. Furthermore, knowing whether the sound is above or below the horizontal plane is not very useful for playback in a binaural format. On the other hand, if the microphone plane is vertical, then “above the plane” can refer to “in front of the device” and “below the plane” can refer to “behind the device” (or vice versa). In vertical orientations of the microphone plane, whether the sound emanates from in front of or behind the device is useful information.

[0026] Stereo audio can be recorded with two omnidirectional microphones that are separated from each other in a horizontal direction. Directional microphones generally cannot be used for recording stereo audio in such a configuration because of their directionality, which facilitates their operability only in certain orientations.

[0027] However, there are many uses for directional microphones in mobile devices. Such uses include, for example, surround sound capture for video recordings and surround sound teleconferencing. In any use, however, the micro-